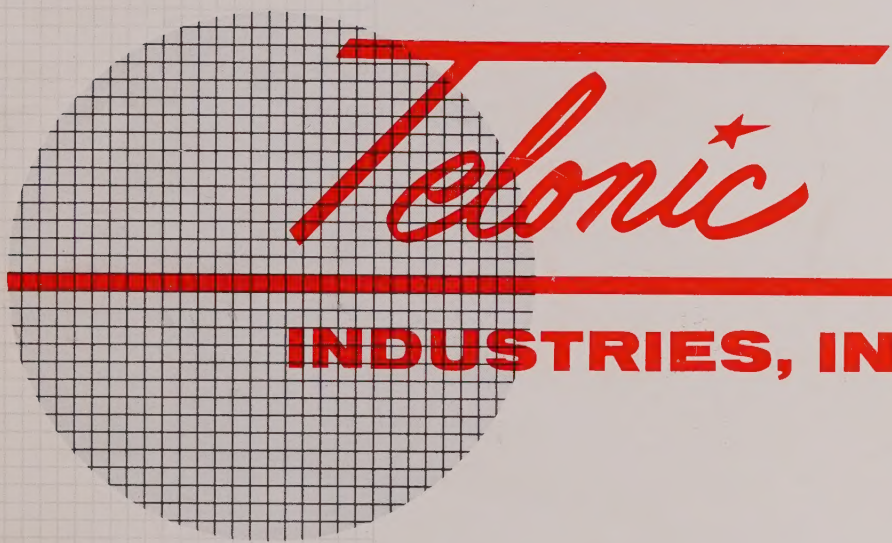
# INSTRUCTION MANUAL




INDUSTRIES, INC

**MODEL** L5-XA1

**SERIAL NO.** 10593

**SWEEP GENERATOR**

*Telonic* INDUSTRIES, INC. BEECH GROVE, INDIANA

# WARRANTY

## TELONIC INSTRUMENTS AND ACCESSORIES

Products manufactured by TELONIC INDUSTRIES, INC. are guaranteed against defective materials and workmanship for a period of one year (vacuum tubes and semiconductors excepted) from date of purchase. This warranty does not apply to instruments that have been altered, improperly handled or damaged in any way beyond our control.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

## CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time, and to furnish merchandise in accordance with current specifications, without incurring any liability to modify equipment previously sold.

## RETURNING EQUIPMENT TO FACTORY

Factory service is available for repair and readjustment of this instrument. However, a description of the trouble should be forwarded FIRST, whereupon instructions for correcting the trouble OR authorization for returning the equipment will be given. This applies to all units, whether under warranty or not.

# SPECIFICATIONS

## MODEL L5-XA1 SWEEP GENERATOR

| | |
|---|---|
| CENTER FREQUENCY | 21 to 39 mcs. (the frequency control includes a dial calibration in megacycles and a 0 to 100 logging scale with a 10:1 vernier indicator. The mechanism provides for 1:1 tuning or 50:1 vernier action.) |
| SWEEP WIDTH | .05 to 40% of center frequency. |
| OUTPUT | |
| Voltage | .1 microvolts to 1 volt RMS (metered). |
| Impedance | 50 ohms. |
| Flatness | ±.25 db. over maximum sweep width. |
| ATTENUATION | |
| Toggle Switch | 30,30,20,20,20,10,5,3,2,1 db. (Accuracy: Overall accuracy at 30MC is held to .5 db. for any combination of switches. Hermetically sealed deposited carbon resistors, having an accuracy of .5% are used.) |
| Vernier | Approximately 0 to 10 db. |
| DISPLAY LINEARITY | Better than 1.2:1. |
| RADIATION | To permit attenuation to 0.1 microvolt. |
| SWEEP RATE | Line frequency (50-60 cps.) |
| ZERO BASE LINE | Oscillator off during return sweep. |
| SCOPE HORIZONTAL SWEEP | Approximately 25 volts peak to peak. |
| SOURCE VSWR | Below 1.2:1. |
| POWER | 115 volts, 50-60 cps. Approximately 75 watts. |
| MARKER SYSTEM | |
| External Marker Input | An external CW Signal of approximately 0.1 volts may be used to produce a "birdy" type marker. |
| Harmonic Markers | Crystal-Controlled Harmonic Markers spaced every 1MC across the whole band. |
| Variable Marker Provisions | Input connections on the rear panel as well as mixers and control circuitry permit the use of the M5-X to produce two variable markers. |
| Birdy-By-Pass Marker Circuitry | The output of the marker oscillators are mixed with a signal from the sweep oscillator to produce beatnotes or birdies. These are amplified and superimposed upon the detected RF output signal before it is applied to the Scope Vertical Input. Amplitude and width of the markers are adjustable over a wide range. |
| PHYSICAL DESCRIPTION | Panel Size - 8 3/4" x 19".<br>Chassis Size - 2" x 14½" x 17".<br>Bench models are enclosed in a hinged top grey and black satin cabinet. For rack mounting, units are enclosed by dust covers. |

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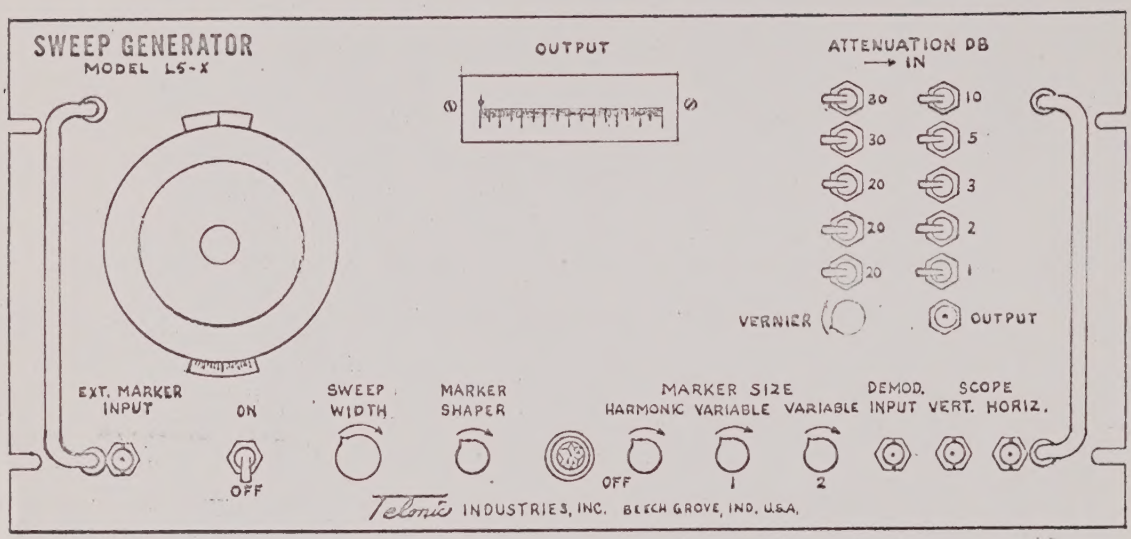
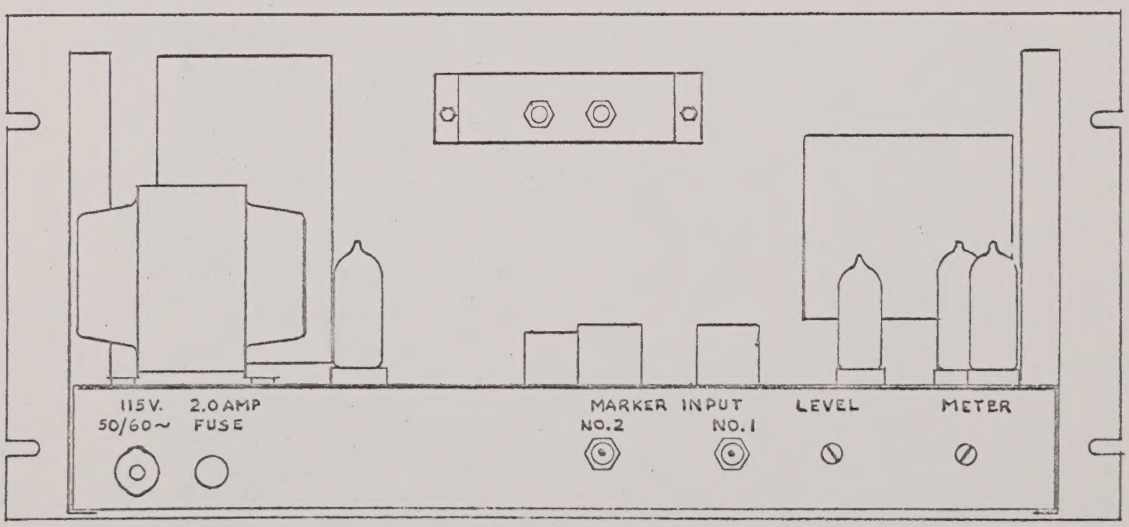

SWEEP GENERATOR
MODEL LS-X
OUTPUT
ATTENUATION DB
IN
30
30
20
20
20
10
5
3
2
1
VERNIER
OUTPUT
EXT. MARKER INPUT
ON
OFF
SWEEP WIDTH
MARKER SHAPER
MARKER SIZE
HARMONIC VARIABLE
VARIABLE
OFF
1
2
DEMOD. INPUT
SCOPE VERT.
HORIZ.
Telonic INDUSTRIES, INC. BEECH GROVE, IND. U.S.A.

FRONT


115V. 50/60~
2.0 AMP FUSE
MARKER INPUT NO.2
NO.1
LEVEL
METER

REAR

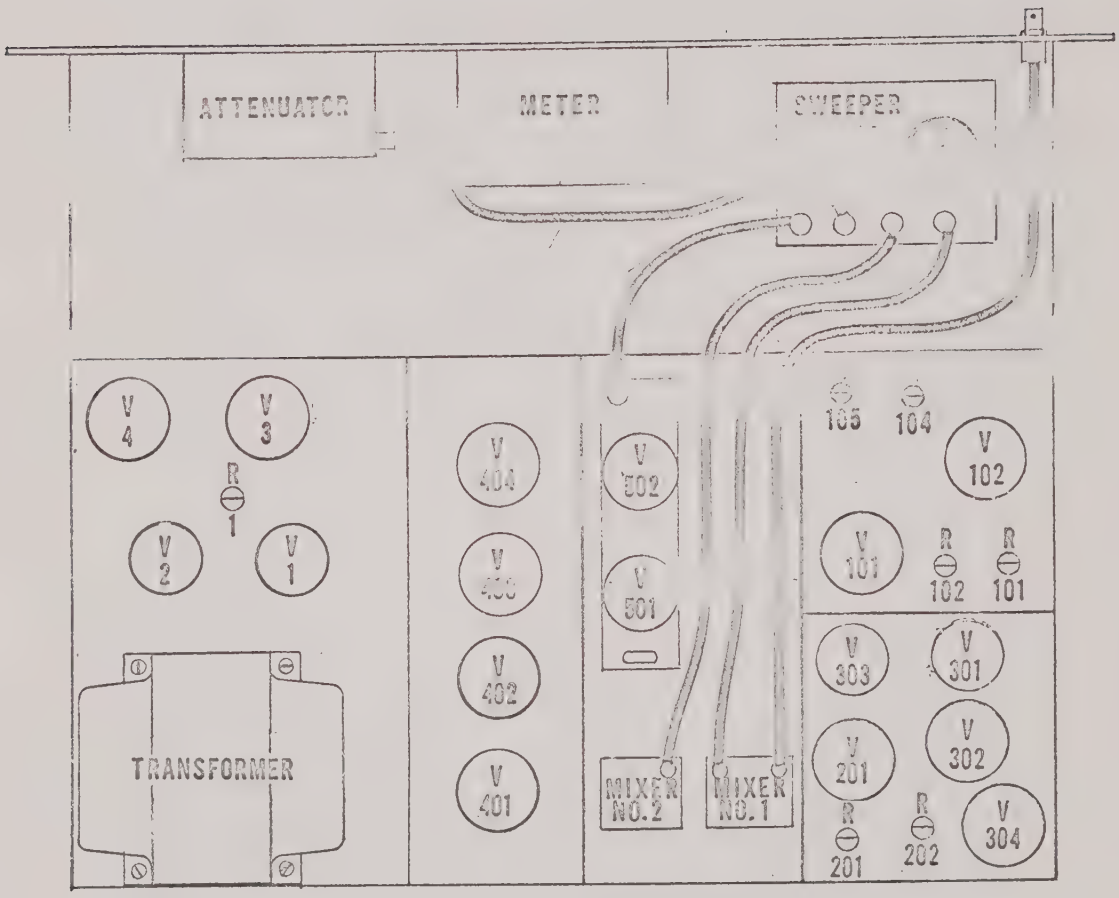
## DESCRIPTION OF FRONT PANEL

| | |
|---|---|
| SWEEP DIAL | Approximately center frequency of sweep. |
| TOGGLE SWITCH ATTENUATOR | Provides the indicated amounts of attenuation. |
| VERNIER ATTENUATOR | 0-10 db. of vernier attenuation. |
| OUTPUT | Sweep output 50 ohms (BNC Connector). |
| OUTPUT METER | Indicates the output voltage supplied to the Toggle Switch Attenuator from the Vernier Attenuator. |
| EXTERNAL MARKER INPUT | Marker input for external signal source. |
| POWER ON/OFF | Power switch. |
| SWEEP WIDTH | This potentiometer is used to vary the amount of drive supplied to the variable inductance and can be used to adjust the sweep width. |
| MARKER SHAPER | Varies the width of the marker signals. |
| PILOT LIGHT | Use #47 bulb for replacement. |
| MARKER SIZE | |
| Harmonic | Varies the amplitude of the harmonic markers and turns marker off in the extreme counter clockwise position. |
| Variable 1 | Varies the amplitude of the marker signals from oscillator 1 in the Marker Generator unit and the external marker input. |
| Variable 2 | Varies the amplitude of the marker signals from oscillator 2 in the marker generator. |
| DEMODULATED INPUT | The demodulated signal from the device being tested is fed into this connector so that marker signals may be superimposed. |
| SCOPE | |
| Vertical | This connector should be connected to the vertical input terminals of the scope for viewing the demodulated signals and markers. |
| Horizontal | This connector should be connected to the scope horizontal amplifier input. |

## DESCRIPTION OF REAR PANEL

| | |
|---|---|
| MARKER INPUT | |
| No. 1 | The marker signal from oscillator number 1 in the M5-X unit is fed into this connector. |
| No. 2 | The marker signal from oscillator number 2 in the M5-X unit is fed into this connector. |
| LEVEL | Controls the average voltage supplied to the sweep oscillator and is used to adjust the RF output level. |
| METER | Used to calibrate the meter. |

# CHASSIS LAYOUT

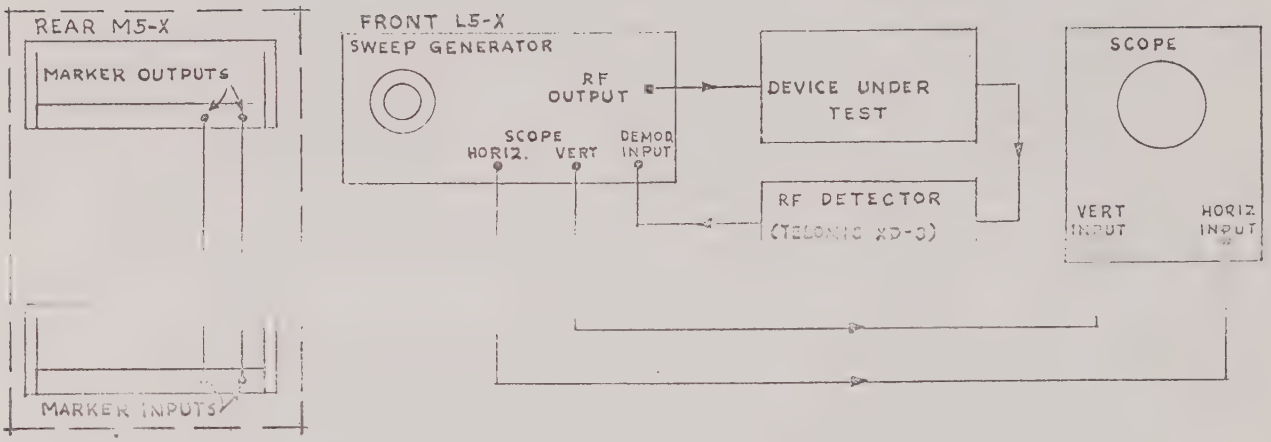



| POWER SUPPLY | | HORIZONTAL AND SWEEP DRIVE | | BLANKING | | LEVELER | |
|---|---|---|---|---|---|---|---|
| V1 | 5651 | V101 | 12AX7 | V201 | 12AX7 | V301 | 6AU6 |
| V2 | 6AU6 | V102 | EL84/6BQ5 | | | V302 | 12AX7 |
| V3 | EL84/6BQ5 | | | | | V303 | 6AU6 |
| V4 | EL84/6BQ5 | | | | | V304 | EL84/6BQ5 |

| BIRDY-BY-PASS AMPLIFIERS | | HARMONIC GENERATOR | | SWEEPER | |
|---|---|---|---|---|---|
| V401 | 12AX7 | V501 | 12AV7 | V801 | 12AV7 |
| V402 | 12AX7 | V502 | 12AV7 | | |
| V403 | 12AX7 | | | | |
| V404 | 12AX7 | | | | |

# DESCRIPTION OF CHASSIS CONTROLS

| | |
|---|---|
| R1 - B+2 ADJUST | This control varies the bias on the amplifier, V2, for the B+ regulator, V3, and is adjusted to produce a regulated B+ voltage (B+2) of 175 volts. |
| R201 - BLANKING PHASE | This control adjusts the phase of the Blanking Pulse with reference to the phase of the Horizontal Sweep Voltage and the Sweep Oscillator. |
| R202 - BLANKING WIDTH | This control is the grid resistor for the Blanking Pulse Generator, V201. It is adjusted to blank one-half of the sweep cycle to produce a zero base line. |
| R101 - SWEEP WIDTH LIMIT | This potentiometer controls a voltage supplied to the front panel Sweep Width control and is used to adjust the sweep width when the front control is set at maximum. |
| R102 - CENTERING | Controls the average current through the saturable reactor which in turn controls the center frequency of the Sweep Oscillator. |
| R105 - LINEARITY | Adjusts the Display Linearity of the high frequency side. |
| R104 - LINEARITY | Adjusts the Display Linearity of the low frequency side. |




TYPICAL SET UP - The following procedure is recommended for setting up this instrument in test position.

1. Connect unit to proper power line voltage and turn POWER ON switch to ON position.

2. Make connections to the scope, the device under test, and RF Detector as shown above. All connectors located on the sweep generator are BNC type and it is recommended that RG cable be used for all connections. This insures good ground connection between each device, minimizes hum, leakage from unit, and pick up of spurious external signals. The cable that is used to connect the RF OUTPUT to the device under test should match the impedance of the sweep generator. If the input impedance of the device under test is different from the impedance of the sweep generator, a matching network should be used to insure a constant input signal.

3. Adjust the RF output level by means of the VERNIER ATTENUATOR control and the TOGGLE SWITCH RF ATTENUATOR to the proper input signal for the device being tested. Failure to do this will result in incorrect reading on the scope.

4. Adjust the SWEEP WIDTH control and center frequency SWEEP DIAL to cover the desired frequency range.

5. MARKERS
Markers may be produced by one or more of the following methods:
   A. Built-in IMC Harmonic Generator.

   B. External CW signal.

   C. The two CW Oscillators in the M5-X unit can be used to produce two variable markers.

Three separate SIZE controls are used to control the Marker Size. One for the IMC Harmonics; one for Oscillator #1 in the M5-X and the External Marker, and one for Oscillator #2 in the M5-X.
The width of all markers is controlled with the MARKER SHAPER control.

# INTERNAL CONTROL ADJUSTMENT

The internal controls are adjusted at the factory and normally do not require any readjustment, however, should it be desirable to check these adjustments, follow these steps:

1 - Connect unit as shown under operating instructions but omit the device under test. Set attenuator switches and vernier for maximum RF Output. Set SWEEP WIDTH control in its maximum clockwise position. Set MARKER SIZE controls in their counter-clockwise position. The recommended detector for this unit is the Telonic XD-3. Turn unit on.

2 - B+2 ADJUSTMENT: Adjust R1 to provide a regulated B+ voltage of 175 volts (blue wire).

3 - BLANKING PHASE and WIDTH ADJUSTMENT: Adjust the BLANKING PHASE control, R201, and the BLANKING WIDTH control, R202, to produce a rectangular pattern on the scope.

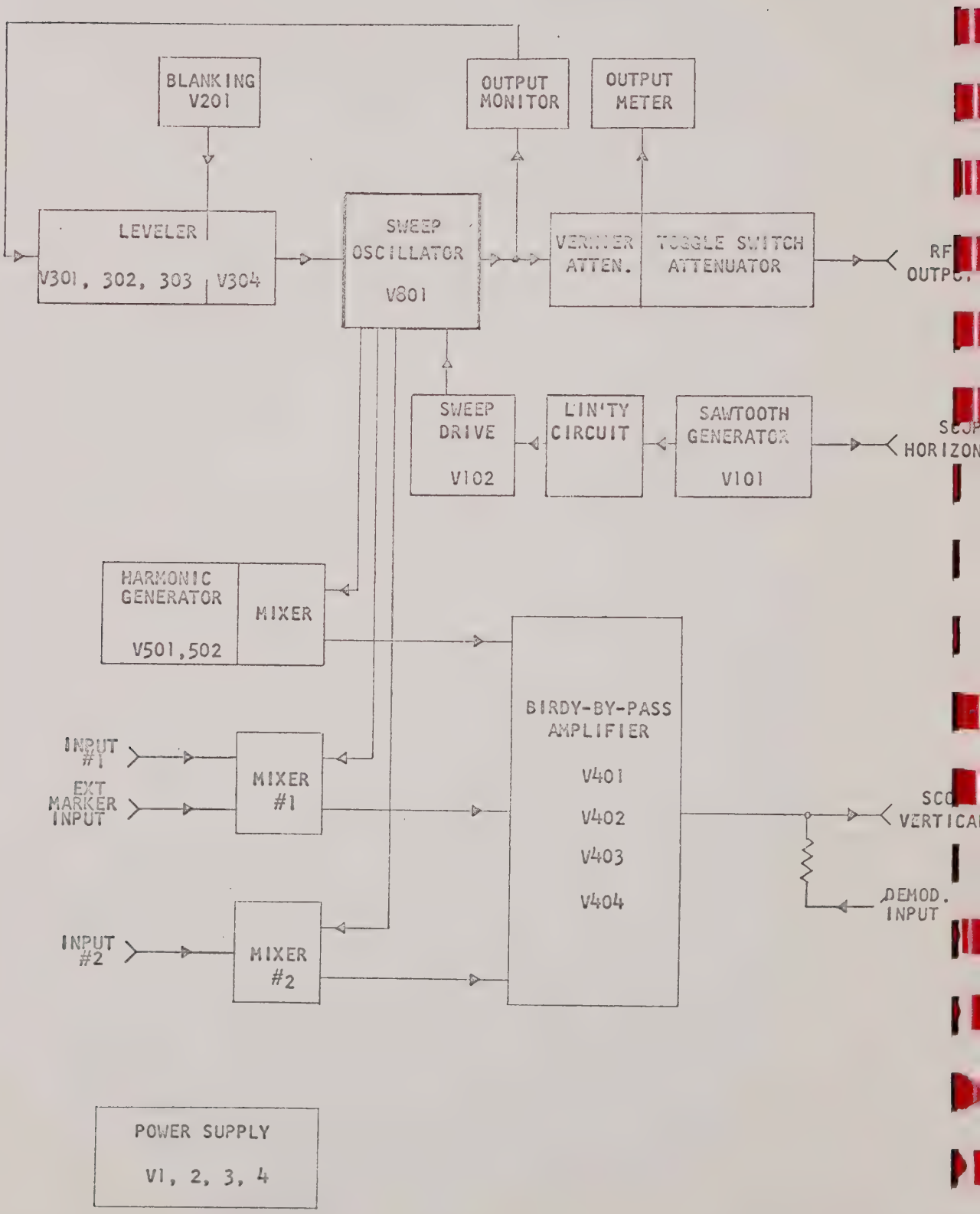
4 - METER CALIBRATION: A Hewlett-Packard 430B Power Meter and 477B Thermistor Mount or their equivalent are required for this adjustment. Connect the RF Output to the thermistor mount. Switch the 3 db. pad to its in position. Temporarily remove V201 from its socket (this will cause the output meter to be overloaded but not sufficient to cause damage). Adjust Vernier Attenuator Knob on the Front Panel until the power meter reads 10 mil... . If sufficient output cannot be obtained with the VERNIER control on the Front Panel, the LEVEL control on the Rear Panel can be adjusted. Once a reading of 10 milliwatts has been obtained on the power meter, do not adjust VERNIER ATTENUATOR or LEVEL control until after the meter has been calibrated. Next replace V201 in its socket and adjust the METER control on the Rear Panel until the output meter reads exactly 1 volt RMS.

5 - LEVEL ADJUSTMENT: With the VERNIER ATTENUATOR control on the Front Panel in its maximum clockwise position, adjust the LEVEL control on the Rear Panel until the output meter reads 1.2 volts RMS.

6 - CENTERING ADJUSTMENT: Set the Sweep Oscillator Dial to 30 mcs. and the Front Panel SWEEP WIDTH control to its maximum clockwise position. Set the CW OSCILLATOR #2 in the M5-X unit to 30 mcs. and adjust the MARKER SIZE control, VARIABLE 2, until the marker is of convenient size (if the M5-X unit is not available, inject an accurate 30 mc. signal into the External Marker Input and use MARKER SIZE control, VARIABLE 1, to adjust its size. Slowly turn the SWEEP WIDTH control to its counter-clockwise position. If necessary, adjust the CENTERING control, R102, to keep the 30 mc. marker in the center of the display.

7 - SWEEP WIDTH and LINEARITY ADJUSTMENT: Turn the Front Panel MARKER SIZE control, HARMONIC, until the 1 mc. harmonic markers are of convenient size. Set the SWEEP WIDTH control to its maximum clockwise position and Sweep Oscillator Dial to 30 mcs. Adjust the SWEEP WIDTH LIMIT control, R101, until the highest marker seen on the display is 36 mcs. Next adjust LINEARITY control, R104, until the lowest marker seen on the display is 24 mcs. Adjust LINEARITY control, R105, for equal distance between the 1 mc. markers on the high frequency side of the display. Since some inner action exists between the setting of these controls, recheck the adjustments of the SWEEP WIDTH LIMIT control, R101, and the LINEARITY control, R104.

# BLOCK DIAGRAM



SWEEP OSCILLATOR: The sweep oscillator is a fundamental frequency type and uses a saturable reactor to obtain the sweep. This sweep voltage is adjusted to the desired center frequency by varying the oscillator tank capacity with the Front Panel Sweep Dial.

SATURABLE REACTOR: The saturable reactor consists of a signal winding and a control winding. The inductance of the signal winding is varied at a 60 cycle rate by the control winding current. This varying current is supplied by the sweep drive tube V102. The average current through this tube is adjusted by varying the bias on the grid by means of the CENTERING Control. This current will partially saturate the signal winding and set the operating point of the saturable reactor so that as the current is varied above and below this value, the inductance of the signal winding will also vary linearally above and below its partially saturated value.

LINEARITY CIRCUIT: Saturable reactors exhibit some nonlinearity when operating at maximum sweep width. As the current increases in the control winding and the reactor begins to saturate, the inductance change for a given current change becomes smaller. To correct this, the 60 cycle sawtooth drive voltage applied to the grid of the sweep drive tube is shaped by the linearity circuit which consists of 3 diodes and a biasing network for the diodes. The effect of this circuit is to cause the current in the control circuit to change at a faster rate as the reactor approaches saturation, thus counteracting the slower inductance change.

HORIZONTAL SWEEP AND SATURABLE REACTOR DRIVE VOLTAGE: The sawtooth voltage for the scope horizontal sweep and the saturable reactor drive tube is produced by V101. A 6.3 volt sine wave is applied to the grid of one of the triode sections of V101. The tube then clips and amplifies the grid signal so that a square wave is produced at the plate. This square wave is then integrated by an RC network in the plate circuit to produce the sawtooth voltage. This sawtooth voltage is then applied to the second triode section of V101, which is connected as a cathode follower and produces the same sawtooth voltage. This voltage is then applied to the horizontal output connector on the Front Panel and to the linearity circuit.

BLANKING CIRCUIT: The purpose of the blanking circuit is to produce a zero base line by removing B+ from the sweep oscillator during the sweep retrace. The blanking voltage is originated by a square wave producing circuit. A phased 6.3 volt sine wave is squared and amplified by the blanking tube. This square wave output of V201 controls V304 (EL84), the sweep oscillator voltage regulator tube, and thus deprives the sweep oscillator of voltage during one-half of each cycle. PHASE and WIDTH Controls are provided for adjusting this blanking voltage to coincide with the horizontal and sweep drive signals.

AUTOMATIC OUTPUT LEVELING CIRCUITRY: The sweep oscillator output is detected by the monitor, amplified in a D.C. amplifier, and used to control the plate voltage of the sweep oscillator. The LEVEL Control adjusts the bias on the first stage of the amplifier. This causes the DC levels in the entire amplifier to change, and varies the average B+ supplied to the sweep oscillator from a minimum of 25V to over 100V. A small decrease in the monitor voltage causes a large increase in the B+ supplied to the RF oscillators, and thus counteracts any amplitude variation. The operation of this circuit and of the sweep oscillator can be checked at the feed-thru

capacitor on the end of the Attenuator Box or Pin 1 of V301. The waveform at this point will normally show a flat output level over the entire band. Adjusting the LEVEL Control will change this level.

The monitor circuit consists of two (2) diodes in a full wave voltage doubler circuit. The use of the full wave detector prevents erroneous leveling information from occurring due to harmonic content and also provides a higher sampling voltage to control the leveling amplifier. The crystal diodes are mounted in such a way as to produce a negative output which is equal to about 75% of the peak to peak RF voltage.

POWER SUPPLY: The power transformer output of 140 volts AC is fed into a half wave voltage doubler, using silicon rectifying elements CR1 and CR2. B+ is taken off the capacity input filter to provide +375 volts unregulated to the plates of V3, (B+ Regulator Pass Tube), V304 (Oscillator Pass Tube), and V4 (Marker B+ Pass Tube).

B+2 is the output of the electronic regulator circuit, consisting of V2 and V3, and provides +175 volts regulated. Potentiometer R1 controls the operating point of V2, regulator amplifier, and is set for proper B+2 output voltage.

B+3 is obtained by biasing the grid of V4 at approximately 85 volts positive, which causes current to flow through cathode resistor R20. The voltage at Pin 3, V4, is supplied to the Plug-In Markers and maintains its regulation due to the low impedance characteristics of the cathode follower circuit and provides approximately 100 volts.

The B- voltage is obtained by the half wave Silicon rectifier CR3. Regulator tube V1 maintains this voltage at -82 volts, and supplies bias voltage to the leveler circuit as well as a reference voltage for the electronic regulator.

Resistor R4 acts as a fuse, protecting the transformer and rectifiers from overload.

The primary of the power transformer is normally wired for 115 volt AC line operation. However, it can be converted to operate from a 230 volt AC source if desired. This conversion is described in the Maintenance Section.

# MARKER SYSTEM DESCRIPTION

## GENERAL

A sample of the sweep signal is mixed with the marker signal to produce beatnotes or birdies. These birdies are then amplified and superimposed upon the demodulated swept signal and applied to the Vertical Amplifier of the oscilloscope. The size and the width of the markers may be varied over a wide range by the SIZE and SHAPER controls of the Birdy-By-Pass Amplifier.

## MARKER INPUT #1

The marker output from OSCILLATOR #1 in the M5-X unit is connected to the MARKER INPUT #1 connector on the Rear Panel of this unit. This signal is then fed into MIXER #1 where it is combined with a signal from the Sweep Oscillator. The resultant birdy is then fed into the Birdy-By-Pass Amplifier.

## EXTERNAL MARKER INPUT

An external CW signal of approximately .1 volts may be connected to the EXT MARKER INPUT connector on the Front Panel of this unit. This signal is then fed into MIXER #1 where it is combined with a signal from the Sweep Oscillator. The resultant birdy is then fed into the Birdy-By-Pass Amplifier.

## MARKER INPUT #2

The marker output from OSCILLATOR #2 in the M5-X unit is connected to the MARKER INPUT #2 connector on the Rear Panel of this unit. This signal is then fed into MIXER #2 where it is combined with a signal from the Sweep Oscillator. The resultant birdy is then fed into the Birdy-By-Pass Amplifier.

## IMC HARMONIC MARKERS

These markers originate from a IMC crystal-controlled pierce oscillator. The output from the crystal oscillator is fed into a two stage amplifier which serves to amplify and distort the IMC signal to produce an output rich in harmonics. These harmonics are then combined with a signal from the Sweep Oscillator in a Diode Mixer. The resultant birdies are then fed into the Birdy-By-Pass Amplifier.

## BIRDY-BY-PASS AMPLIFIER

In order to control the size of the markers separately, the Birdy-By-Pass Amplifier has three separate inputs. The size of each input can be controlled by the Front Panel SIZE controls. One input is used for VARIABLE MARKER #1 and the EXT MARKER; one input is used for VARIABLE MARKER #2, and one input is used for the IMC Harmonic Markers. After passing through the necessary circuitry for controlling the marker size, the three signals are then combined together. The combined marker signals are then fed through the shaper circuit. The frequency response of this circuit is controlled by the Front Panel SHAPER control which in turn varies the width of the marker signals.

After passing through the shaper circuit, the marker signals are fed to the SCOPE VERTICAL connector on the Front Panel where they are combined with the demodulated swept signal and then connected to the vertical input terminals of the scope.

# db/VOLTAGE EQUIVALENT

| db | VOLTS RMS | db | MILLIVOLTS RMS | db | MICROVOLTS RMS | db | MICROVOLTS RMS |
|---|---|---|---|---|---|---|---|
| 0 | 1.00 | 21 | 89 | 61 | 890 | 111 | 2.8 |
| 1 | .89 | 22 | 79 | 62 | 790 | 112 | 2.5 |
| 2 | .79 | 23 | 71 | 63 | 710 | 113 | 2.2 |
| 3 | .71 | 24 | 63 | 64 | 630 | 114 | 2.0 |
| 4 | .63 | 25 | 56 | 65 | 560 | 115 | 1.8 |
| 5 | .56 | 26 | 50 | 66 | 500 | 116 | 1.6 |
| 6 | .50 | 27 | 45 | 67 | 450 | 117 | 1.4 |
| 7 | .45 | 28 | 40 | 68 | 400 | 118 | 1.3 |
| 8 | .40 | 29 | 35 | 69 | 350 | 119 | 1.1 |
| 9 | .35 | 30 | 32 | 70 | 320 | 120 | 1.0 |
| 10 | .32 | 31 | 28 | 71 | 280 | 121 | .89 |
| 11 | .28 | 32 | 25 | 72 | 250 | 122 | .79 |
| 12 | .25 | 33 | 22 | 73 | 220 | 123 | .71 |
| 13 | .22 | 34 | 20 | 74 | 200 | 124 | .63 |
| 14 | .20 | 35 | 18 | 75 | 180 | 125 | .56 |
| 15 | .18 | 36 | 16 | 76 | 160 | 126 | .50 |
| 16 | .16 | 37 | 14 | 77 | 140 | 127 | .45 |
| 17 | .14 | 38 | 13 | 78 | 130 | 128 | .40 |
| 18 | .13 | 39 | 11 | 79 | 110 | 129 | .35 |
| 19 | .11 | 40 | 10 | 80 | 100 | 130 | .32 |
| 20 | .10 | 41 | 8.9 | 81 | 89 | 131 | .28 |
| | | 42 | 7.9 | 82 | 79 | 132 | .25 |
| | | 43 | 7.1 | 83 | 71 | 133 | .22 |
| | | 44 | 6.3 | 84 | 63 | 134 | .20 |
| | | 45 | 5.6 | 85 | 56 | 135 | .18 |
| | | 46 | 5.0 | 86 | 50 | 136 | .16 |
| | | 47 | 4.5 | 87 | 45 | 137 | .14 |
| | | 48 | 4.0 | 88 | 40 | 138 | .13 |
| | | 49 | 3.5 | 89 | 35 | 139 | .11 |
| | | 50 | 3.2 | 90 | 32 | 140 | .10 |
| | | 51 | 2.8 | 91 | 28 | | |
| | | 52 | 2.5 | 92 | 25 | | |
| | | 53 | 2.2 | 93 | 22 | | |
| | | 54 | 2.0 | 94 | 20 | | |
| | | 55 | 1.8 | 95 | 18 | | |
| | | 56 | 1.6 | 96 | 16 | | |
| | | 57 | 1.4 | 97 | 14 | | |
| | | 58 | 1.3 | 98 | 13 | | |
| | | 59 | 1.1 | 99 | 11 | | |
| | | 60 | 1.0 | 100 | 10 | | |
| | | | | 101 | 8.9 | | |
| | | | | 102 | 7.9 | | |
| | | | | 103 | 7.1 | | |
| | | | | 104 | 6.3 | | |
| | | | | 105 | 5.6 | | |
| | | | | 106 | 5.0 | | |
| | | | | 107 | 4.5 | | |
| | | | | 108 | 4.0 | | |
| | | | | 109 | 3.5 | | |
| | | | | 110 | 3.2 | | |

POWER SUPPLY: Since a defect in the power supply will affect all circuits, it should be checked for proper operation before proceeding to other circuits.

| SUPPLY | NOMINAL VALUE | NORMAL VARIATION | NORMAL RIPPLE | WIRE COLOR* |
|---|---|---|---|---|
| AC Line | 115V | --------- | ------ | ------ |
| B+1 | 375 | ±15 volts | 6 to 15 volts | Red |
| B+2 | 175 | ±.5 volts | 12 to 25 millivolts | Blue |
| B+3 | 100 | +5-10 volts | 15 millivolts to .5 volts | Orange |
| B- | -82 | ±2 volts | 100 millivolts | White |
| 6.3 "A" | 6.3V AC | Main filament supply | | Heavy Duty Green |
| 6.3 "B" | 6.3V AC | 180° out of phase with supply "A". Source of phasing and filament voltages. | | Heavy Duty Gray |
| 6.3 "C" | 6.3V AC | Isolated filament voltage for tubes with cathodes above ground. | | Heavy Duty Brown |

Next: If power supply is operating normal, use the block diagram to isolate the trouble to a major section. Check tubes, diodes, and adjustment of Front Panel and printed wiring board controls located within that section (see Page 7 for adjustment procedure). By the use of the schematic, ordinary difficulties encountered can be readily located and remedied. The following trouble-shooting chart is an additional aid to servicing:

| SYMPTOM | POSSIBLE CAUSE AND REMEDIES |
|---|---|
| Pilot Light Off and Unit Fails to Operate | Fuse open - replace. If second fuse opens - look for cause of overload, shorted wiring, components, etc. |
| B+1 Off Value or Excessive Ripple | Check R4, C1, CR1, and CR2. |
| B+2 Off Value or Excessive Ripple | Check R1 for proper adjustment. Check R15, it will burn out if B+2 is overloaded. Check V1, V2, V3, tubes and circuitry. |
| B+3 Off Value or Excessive Ripple | Check R17 and R21 (these resistors adjust the voltage on the grid of V4, a cathode follower, which in turn determines the voltage on the cathode). Check R18 (this resistor will burn out if B+3 is overloaded). Check V4 and C2. |
| B-Off Value or Excessive Ripple | Check C3, C4, C5, CR3, R3, R5, and R6. Check V1 to see if it is lit properly (should be a steady orange glow). |
| V1 Not Lit Properly | If replacing V1 and checking the above parts does not remedy the trouble, check the line voltage. Low line voltage could cause this trouble. Reducing the value of R3 slightly will usually eliminate this difficulty. |

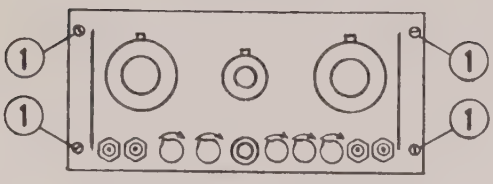
*Wire colors do not apply to shielded wires - single wires only.

| | |
|---|---|
| R.F. Output is Low or Zero | Check R313 - this resistor will burn out if the B+ to the sweep oscillator is overloaded.<br><br>Check B+ to the sweep oscillator, cathode of V304. It should be a positive square wave of 25-100 volts and should vary as the OUTPUT LEVEL control varies.<br><br>If it is normal, look for RF difficulties, defective tube, components, shorted or open wiring, etc.<br><br>If the voltage is low and does not respond to the LEVEL control, remove first V303 and then V201. When either of these tubes conducts, the voltage on the grid of V304 (pin 2) is reduced and thus decreases the B+ to the sweep oscillator. If removal of V201 allows the B+ on V304 (pin 3) to return to normal, check the blanking tube, controls, and associated circuitry. If removal of V303 causes the B+ to return to normal, check the LEVELER controls, V301 and V302, tubes, and associated circuitry. |
| Poor Leveling | Replace monitor diodes. Also replace V301, V302, and V303. V301 is the most critical since it is in the first stage of the D.C. coupled amplifier. Resetting the printed circuit LEVEL controls is sometimes necessary if these tubes are replaced. |
| Weak Markers | Replace 1N82 or 1N34 crystal diode mixer. Check Birdy-By-Pass Amplifier, tubes and circuitry. |
| No Horizontal Output | Look for difficulty in the sawtooth circuitry V101. |
| Insufficient Sweep Width | Check adjustment of CENTERING and LINEARITY controls. (See Page 7). |
| Poor Display Linearity | Check diodes CR101, 102, and 103. Check LINEARITY controls. (See Page 7). |
| Sweep Dial Off Calibration | Check adjustment of CENTERING control. (See Page 7). Replace sweep oscillator tube V801. |

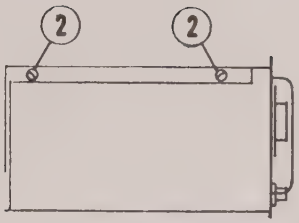
## CONVERSION FOR 230 VOLT POWER LINES

The dual primary of the power transformer is normally wired in parallel for use on 115 volt AC lines. If desired, the windings can easily be reconnected in series for use with 230 volt power. With the aid of the Chassis Layout, bottom view, locate terminals 1, 2, 3, and 4. Remove the jumper wires between terminals 1 and 2 and between terminals 3 and 4. Then install a jumper wire between terminals 2 and 3.

## RACK MOUNTED UNIT



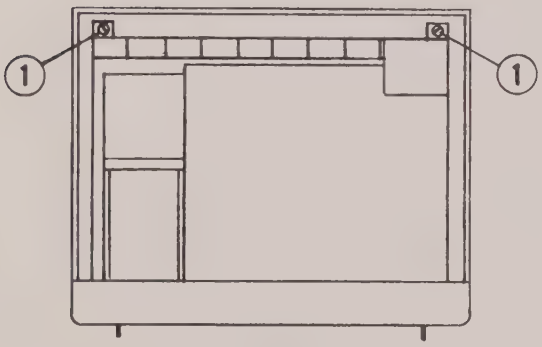

FRONT



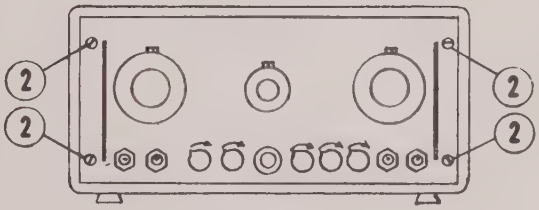

SIDE

Unit has front panel slotted or drilled for standard RTMA Mounting. Position unit in rack and install mounting screws in holes marked 1.
Dust cover removal: Remove four #8-32 thread-cutting screws, marked 2 (two on each side) and lift off cover for easy access to chassis.

## CABINET MOUNTED UNIT




TOP




FRONT

To remove chassis from cabinet; first remove the two #8-32 screws (marked 1 on top view above) at the back of the chassis (one on each side). These screws fasten the chassis to the cabinet guide rails. Second, remove the four #10-32 screws (marked 2 in front view above). The screws hold the panel to the cabinet.

Slide chassis out of cabinet by pulling forward on the two front panel handles.

To replace chassis in cabinet, insert the flanges on the bottom of the chassis side panels into the slot of the cabinet guide rails. Push chassis back into cabinet far enough for the slots in the side panel flanges to align with the retained nut in guide rail. Install the two #8-32 screws and tighten securely. Replace the four #10-32 screws in the front panel.

# PART VALUE INFORMATION

| SCHEMATIC PART DESIGNATION | |
|---|---|
| C | Capacitor |
| CR | Crystal Rectifier, Germanium Diode |
| F | Fuse |
| I | Incandescent Pilot Light |
| J | Jack or termination, Coaxial Connector |
| K | Cable |
| L | Coil |
| M | Meter or Motor |
| P | Plug, Coaxial Connector |
| R | Resistor, Fixed or Variable |
| S | Switch |
| T | Transformer |
| V | Tube |
| Z | Miscellaneous |

| SCHEMATIC VALUE ABBREVIATION | |
|---|---|
| Ω | ohms |
| K Ω | 1,000 ohms |
| M Ω | 1,000,000 ohms (megohms) |
| µf, uf | Microfarad |
| pf | Picofarad |
| µh, uh | Microhenry |
| mh | Millihenry |

RESISTORS - All resistors are 1/2 watt ± 10%, and are shown in ohms, unless otherwise specified.

NOTE: Resistors in the attenuator pads are ± 2%.

CAPACITORS - All Capacitors are shown in picofarads (pf) unless otherwise specified.

COILS - All coils are shown in microhenries (µh) unless otherwise specified.

PARTS LOCATION - F.P. Front Panel
P.C.B. Printed Circuit Board
R.P. Rear Panel
C.H. Chassis
T.P. Test Point

PARTS NUMBERS - LOCATION INFORMATION

1 - 99 - Power Supply
101 - 199 - Horizontal and Alternate Sweep Drive Circuit
201 - 299 - Blanking
301 - 399 - Leveler
401 - 499 - Birdy-By-Pass
501 - 599 - Mixer & Plug-In Markers
601 - 699 - Variable Markers
701 - 799 - Attenuators
801 - 899 - Sweep Oscillator and Sweep Drive Circuit
901 - 999 - Modifications and Special Circuits

*Indicates value of component adjusted at factory, and may deviate from value shown on print.

—O— 16 Indicates printed circuit board terminal.

N O T I C E

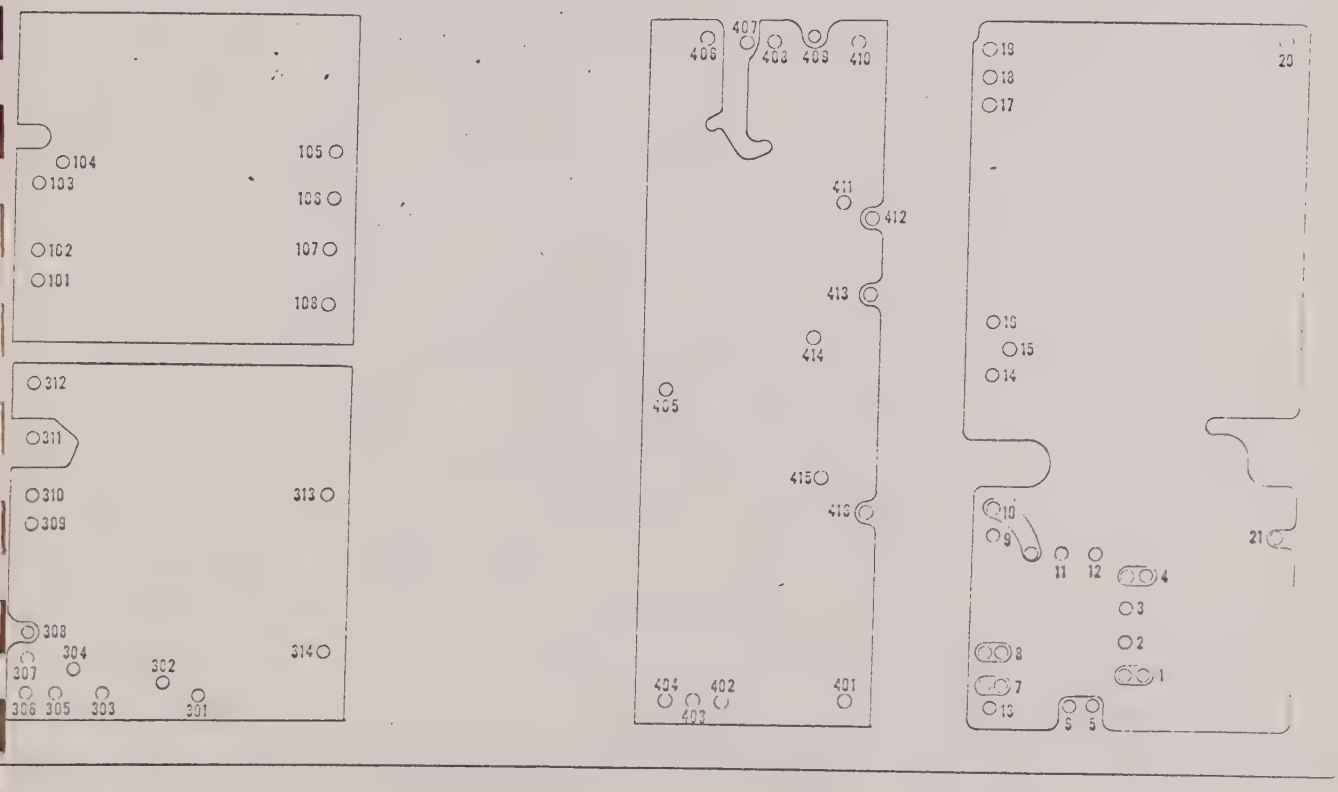
RED LACQUER IS USED TO INDICATE FASTENINGS THAT SHOULD NOT BE DISTURBED FOR ORDINARY SERVICE, AND TO SECURE ADJUSTABLE CONTROLS.

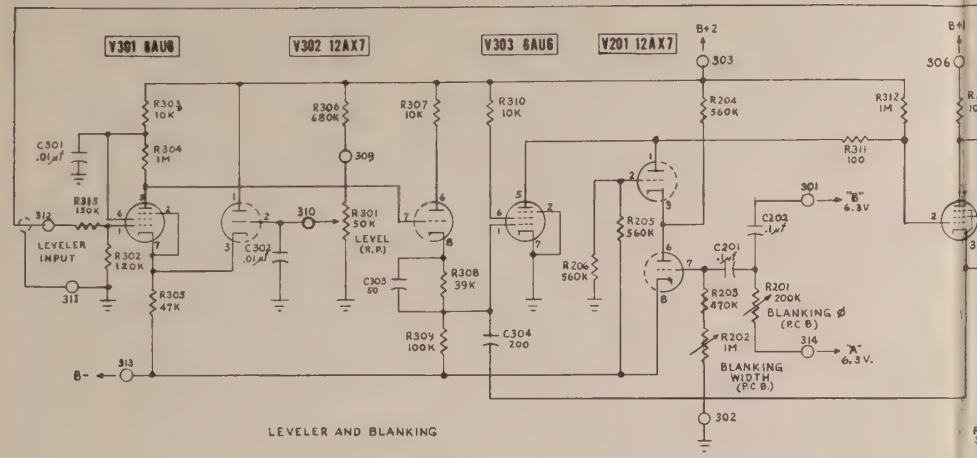
# CHASSIS LAYOUT

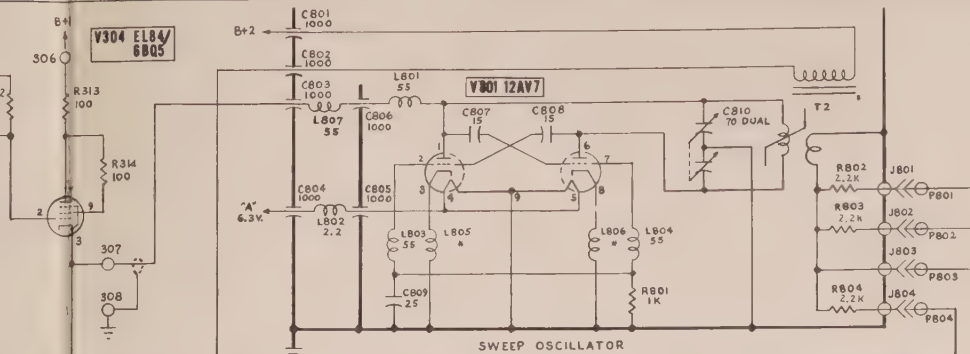
BOTTOM VIEW

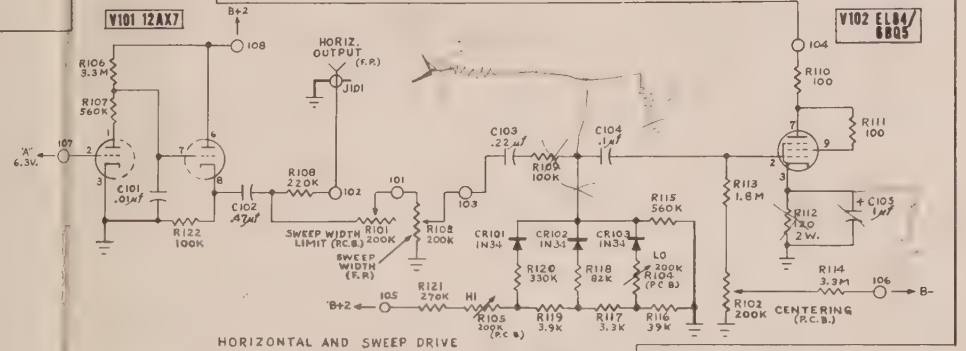
TERMINALS

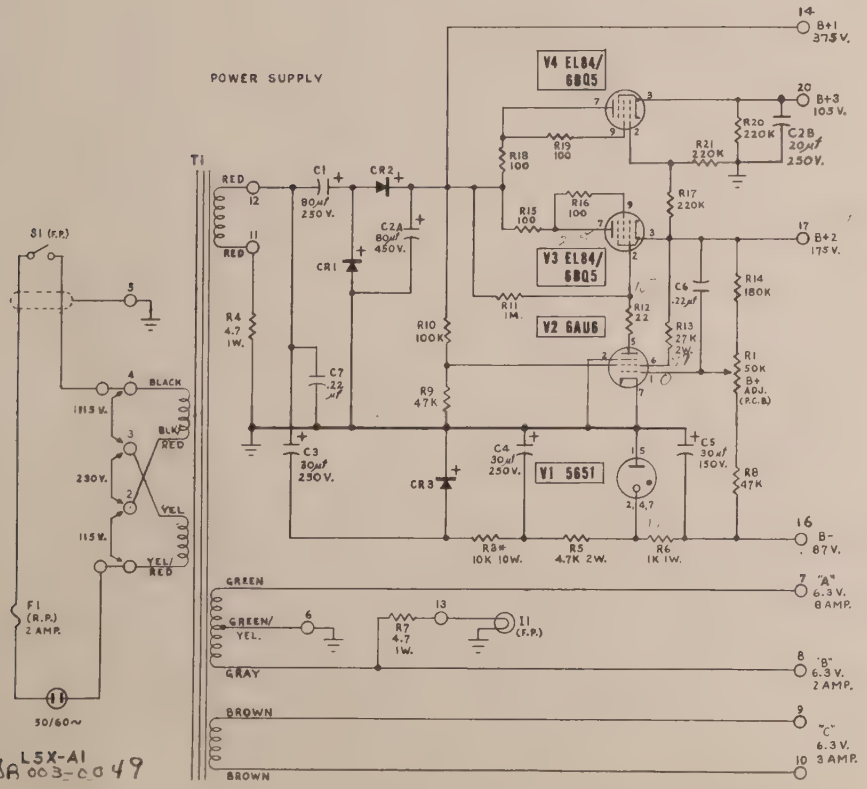
FRONT

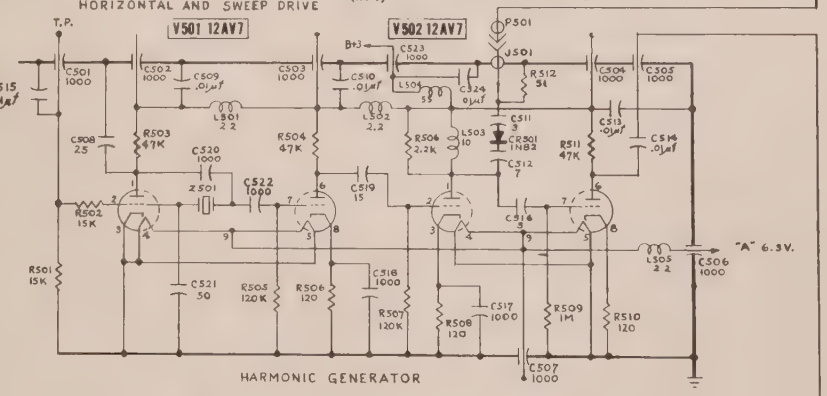


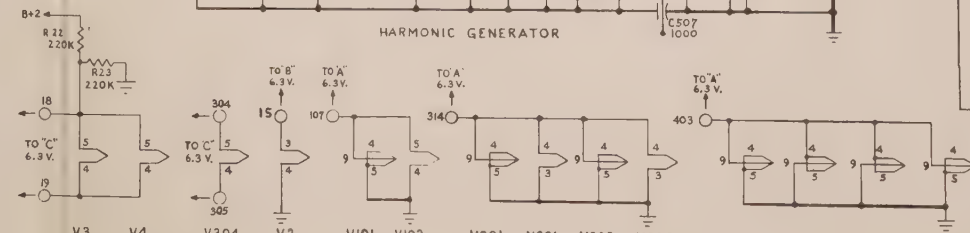
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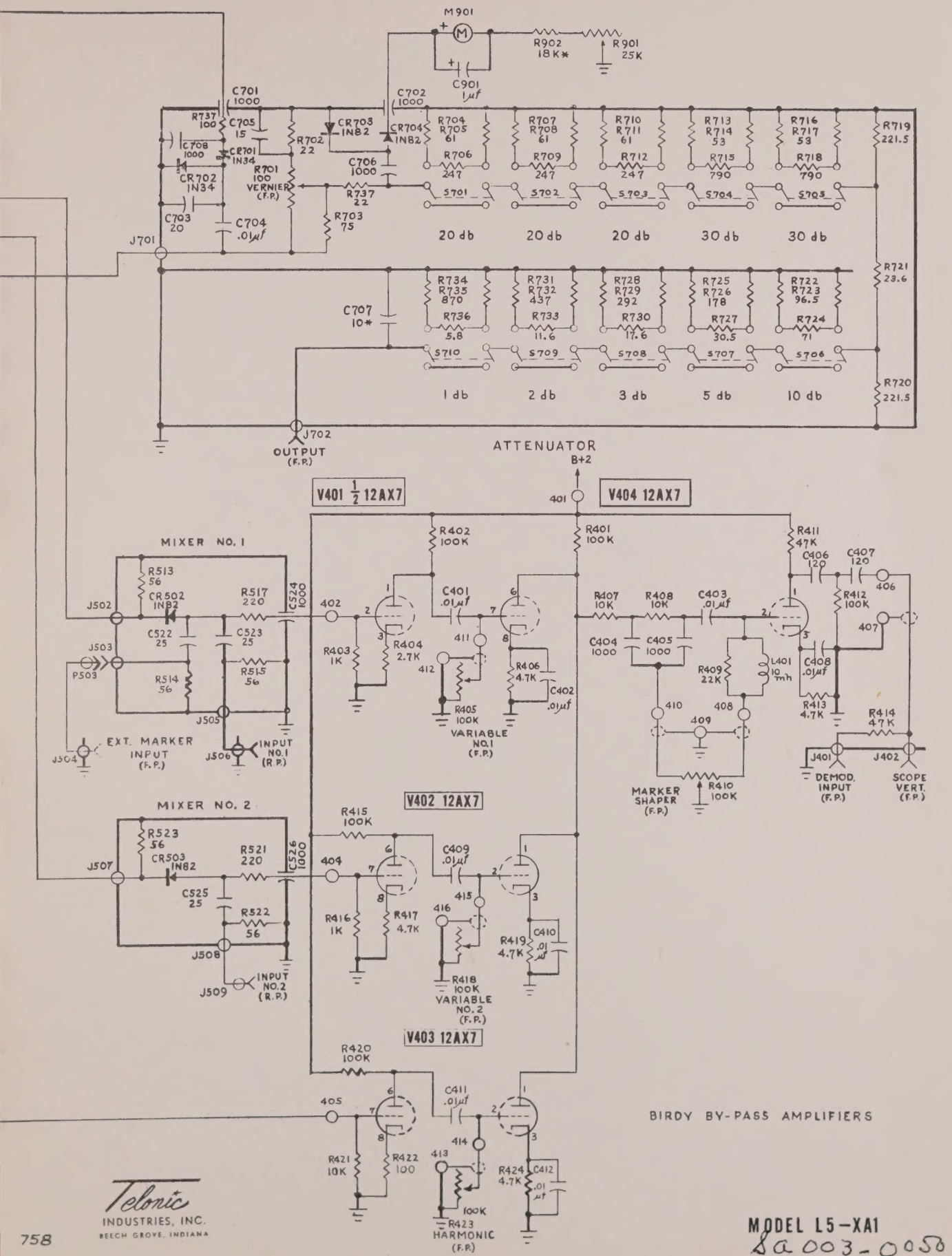
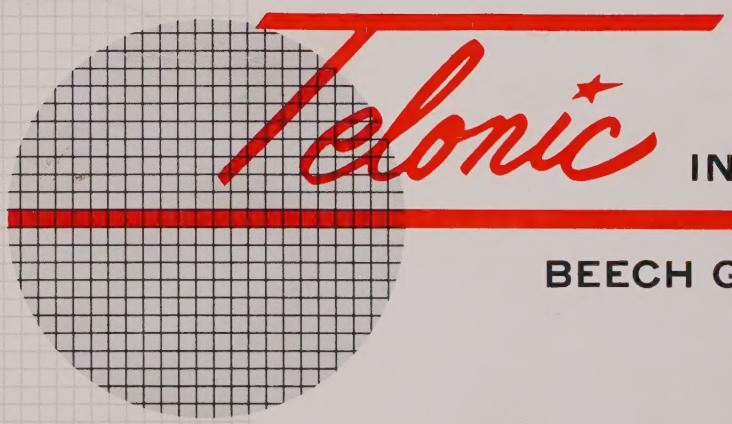



BIRDY BY-PASS AMPLIFIERS

Telonic
INDUSTRIES, INC.
BEECH GROVE, INDIANA



MODEL L5-XA1
La 003-0058

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